

UPDATE FACT SHEET



Bioremediation of Groundwater Speeds Cleanup at Test Area North

WASTE AREA GROUP

1

DEFINITIONS AT A GLANCE

BIOREMEDIATION:

Bioremediation is the use of living things to remediate the environment through the capture or breakdown of environmental contaminants.

TREATABILITY STUDY:

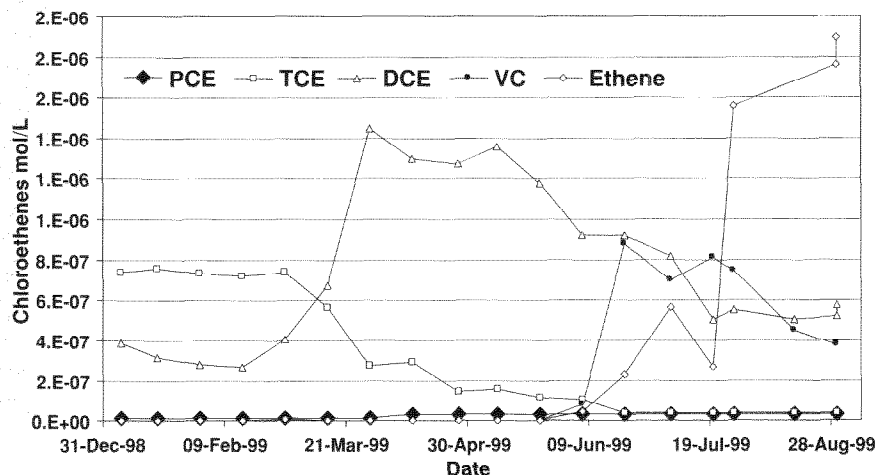
A laboratory or field demonstration of a technology to test its viability as a remediation alternative for a contaminant or contaminated site.

HALF-LIFE:

The half-life is the time it takes for a given amount of a substance, to naturally diminish by half. Though the term is most often used with radioactive substances to indicate the time it takes for them to decay, it also applies to other contaminants, such as organic chemicals, which can be broken down via natural processes into less harmful substances.

In a world first, Idaho National Engineering and Environmental Laboratory science researchers are successfully remediating trichloroethene contamination in a deep fractured-rock aquifer at Test Area North. The one-year study is also the largest bioremediation test of its kind in America. BBWI Principal Engineer Kent Sorenson believes the bacterial processes being pioneered at INEEL will break down the TCE all the way into the harmless constituents ethene and ethane. The mission of the INEEL is to do basic science research of the earth's subsurface and to safely perform subsurface remediation of the environmental legacies remaining from nuclear

Reductive Dechlorination Indicators in TAN-31



The graphic above tracks the levels of five substances in the groundwater beneath TAN, during an eight-month period. As TCE levels drop from roughly 100 ppb to less than 10 ppb (below detection levels), the level of cis-dichloroethene, a breakdown product, first shoots upward to more than 120 ppb, then falls lower and lower. As cis-DCE breaks down, levels of vinyl chloride and ethene are rising, with ethene becoming most prevalent. Ethene is a harmless final breakdown product of TCE.

weapons production during the Cold War era. The science research at TAN has applications throughout America. TCE, an organic degreaser that was widely used in the past, is the most common groundwater contaminant in the United States. Untreated, it has an estimated *half-life* of 7,000 years in the aquifer.

The laboratory is the home base for science solutions which are used to develop new technologies that will benefit the United States and the world. Much of the laboratory's work focuses on environmental remediation. The U.S. Department of Energy, in concert with the U.S. Environmental Protection Agency and the State of Idaho, actively seeks the input of interested parties before the three agencies jointly make remediation decisions.



SLUDGE:

A thick liquid waste form in which the liquid can be water or some other chemical or combination of chemicals, and which also contains solid or particulate waste as well.

ANAEROBIC:

Anaerobic processes are those which take place in the absence of an oxygen-rich environment.

At TAN, where TCE-contaminated *sludge* was formerly injected below ground, environmental engineers are using the same well to inject 300 gallons of sodium lactate per week into the TCE-contaminated groundwater plume. Sodium lactate, a common food-grade preservative, is an electron donor in a complex series of biochemical reactions that ultimately break down the TCE into harmless constituents. Naturally occurring bacteria in the groundwater beneath the INEEL, are doing the dirty work. The bacteria are known as chloro-respirators, in effect "breathing" chlorine compounds to get energy for life processes. These bacteria do not require oxygen for respiration; thus the process is known as *anaerobic* reductive dechlorination.

The addition of sodium lactate is one of five alternatives to the pump-and-treat method, identified for remediating the plume. Of the five, two have been evaluated and rejected. Laboratory studies indicate that the remaining three all hold some promise, but the sodium lactate treatment results are the most encouraging thus far.

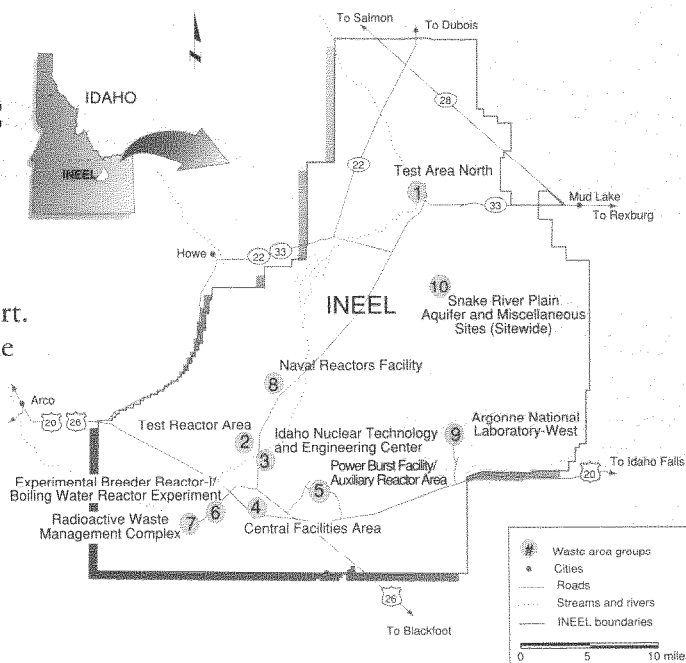
BBWI Principal Engineer Kent Sorenson believes the bacterial processes will break down the TCE all the way into the harmless constituents ethene and ethane. Bacteria ferment the sodium lactate into propionate and acetate, which can be further degraded, donating electrons which provide energy to the bacteria. The ultimate breakdown products of the lactate are bicarbonate, carbon dioxide, and water.

Sampling of the plume has shown TCE reduction in one case from 3800 micrograms per liter down to 10 micrograms per liter. The TCE first is reduced to one or more phases of dichloroethene (DCE), then further reduced to vinyl chloride. Vinyl chloride is the last step before the harmless byproducts of ethene and ethane are produced. Continuing monitoring of the contamination plume from a number of sampling wells around the disposal well has shown a decrease in TCE accompanied by an increase in DCE. Subsequently, DCE concentrations have decreased while vinyl chloride and ethene concentrations have increased significantly. The observation of ethene is important because it demonstrates that the bacteria are degrading TCE completely to harmless byproducts without accumulation of vinyl chloride.

The test lasted through November. Researchers are analyzing data to answer two further questions. One is whether all of the TCE in the groundwater can be reduced to harmless constituents. The second is to show that anaerobic reductive dechlorination can be used to break down the TCE remaining in the disposed sludge, not just the TCE plume in the groundwater.

TEST AREA NORTH BACKGROUND:

The INEEL is an 890-square mile DOE facility on the Eastern Snake River Plain in southeastern Idaho. The plain is a relatively flat, semiarid desert. Drainage within and around the plain recharges the Snake River Plain Aquifer, which flows beneath the INEEL and surrounding area. The top of the aquifer slopes from about



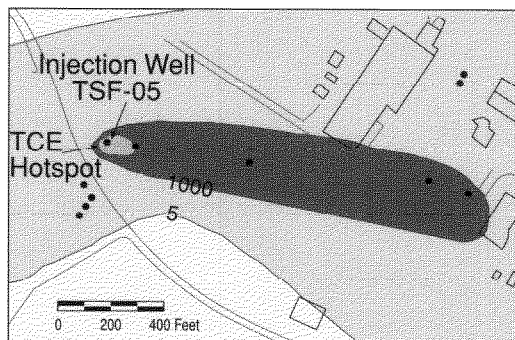
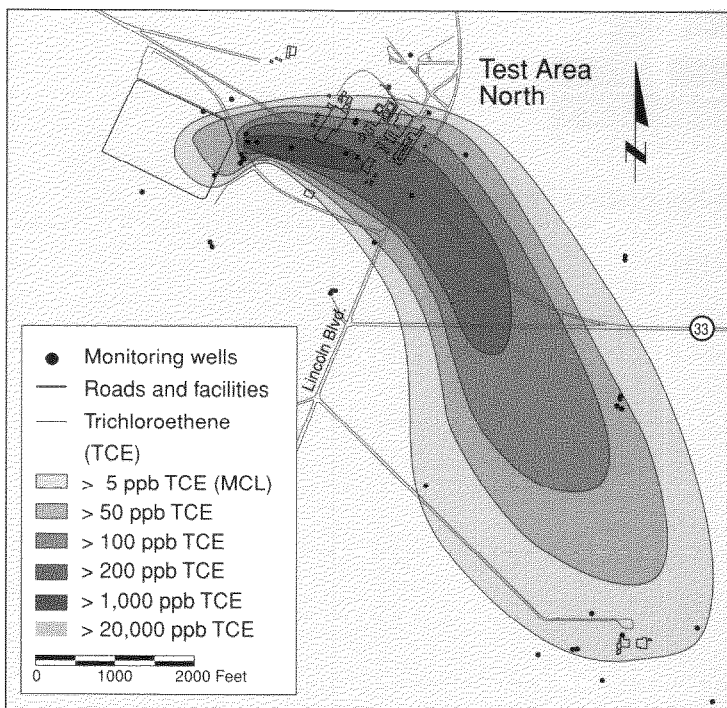
200 feet below the surface at the Test Area North to about 600 feet beneath the surface at the Radioactive Waste Management Complex. The aquifer is overlain by lava flows and sediment.

Because of confirmed contaminant releases to the environment, the INEEL was placed on the National Priorities List of hazardous waste sites in 1989. The Agencies signed the Federal Facility Agreement and Consent Order in 1991 outlining the cleanup process and schedule for the INEEL. To better manage cleanup activities, the INEEL was divided into 10 waste area groups. Test Area North is designated as Waste Area Group (WAG) 1.

Test Area North is in the north-central portion of the INEEL. From 1954 to 1961, the area was used to support the Aircraft Nuclear Propulsion Program, whose mission was to test the concept of a nuclear-powered airplane. From 1962 through the 1970s, the area was principally devoted to the Loss-of-Fluid Test (LOFT) Facility, which was used to perform reactor safety testing and behavior studies. Beginning in 1980, the area was used to conduct research with material from the 1979 Three Mile Island reactor accident. Current activities include the manufacture of armor for military vehicles at the Specific Manufacturing Capability (SMC) Facility and nuclear inspection and storage operations at the Initial Engine Test (IET) Facility, the Technical Support Facility (TSF), and the Water Reactor Research Test Facility (WRRTF).

The main sources of contamination at Test Area North include discharges to an injection well, releases during transfers to and from underground storage tanks, windblown contaminants from another release site, releases in disposal (burn) pits, releases to surface ponds, a mercury spill, and a fuel leak.

The subject of this fact sheet is the bioremediation of trichloroethene (TCE) contamination in the aquifer beneath TAN, and in the *secondary source*. Bioremediation of the TCE is one of five alternative treatment methods being evaluated to augment or replace the pump and treat method already being used to contain the hot spot around the injection well.



CD99 T37-003

SECONDARY SOURCE:

Contamination in an aquifer often disperses as a plume in the water. The secondary source is the origin of the plume remaining long after the original contamination event, such as sludge that has been injected into the ground.

AGENCIES:

Agencies in this fact sheet refers to the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Idaho Department of Health and Welfare, Division of Environmental Quality (DEQ).

PUBLIC INVOLVEMENT

Public input is very important to DOE, EPA, and the state of Idaho. The agencies want to understand your concerns as they continue to remediate Waste Area Group 1. You may request a briefing by calling the INEEL Community Relations Office at (208) 526-4700 or the INEEL's toll-free number at (800) 708-2680.

INFORMATION REPOSITORY/ADMINISTRATIVE RECORD COLLECTIONS

DOE maintains three information repositories throughout Idaho which provide detail on cleanup projects at the INEEL. The information repositories are located at the following addresses.

INEEL Technical Library
DOE Public Reading Room
1776 Science Center Drive
Idaho Falls, ID 83415

Albertson Library
Boise State University
1910 University Drive
Boise, ID 83725

University of Idaho Library
University of Idaho Campus
434 2nd Street
Moscow, ID 83843

The Administrative Record may be accessed on the Internet by typing ar.inel.gov on the command line. If you do not have access to the Internet or an Information Repository, you may call the INEEL's toll-free number at (800) 708-2680 to request an environmental document index or a specific document. For the Waste Area Group 1 comprehensive investigation, refer to the Operable Unit binder 1-07-B in the Administrative Record.

INEEL

Idaho National Engineering & Environmental Laboratory
BECHTEL BWXT IDAHO, LLC



INEEL Environmental Restoration Program
P.O. Box 1625
Idaho Falls, ID 83415-3911

Address Service Requested

STD PRESORT
U.S. POSTAGE
PAID
IDAHO FALLS, ID
PERMIT 73